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(11) **EP 1 382 259 A1**

(12) **EUROPEAN PATENT APPLICATION**

(43) Date of publication:
21.01.2004 Bulletin 2004/04

(51) Int Cl.7: **A21B 7/00**

(21) Application number: **03252439.9**

(22) Date of filing: **16.04.2003**

(84) Designated Contracting States:
**AT BE BG CH CY CZ DE DK EE ES FI FR GB GR
HU IE IT LI LU MC NL PT RO SE SI SK TR**
Designated Extension States:
AL LT LV MK

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(30) Priority: **19.07.2002 KR 2002042588**

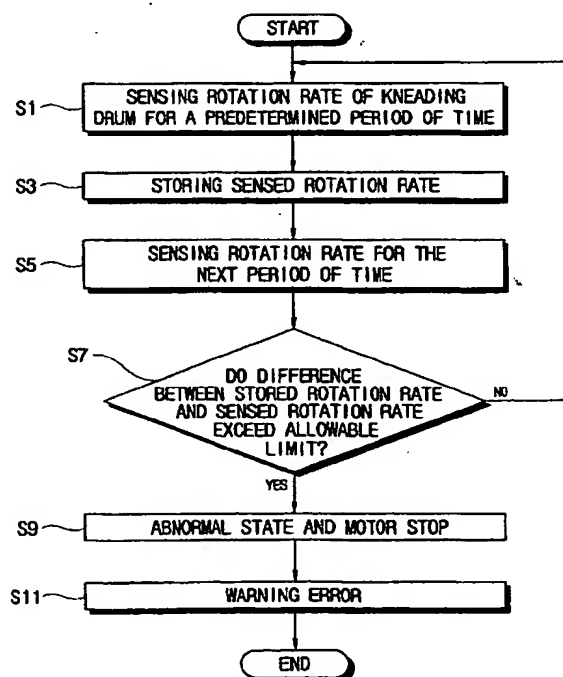
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(54) **Bread maker and control method thereof**

(57) A bread maker including a pair of kneading drums (11, 13) inside an oven compartment (10), to which are attached opposite ends of a mixing bag (7) containing bread ingredients, the kneading drums (11, 13) reversing rotary direction periodically; a drum driving part (25) in an electric component compartment (20) rotating the kneading drums (11, 13); a rotation sensing part (40) sensing a rotation rate of one of the kneading drums (11, 13); and a controller (70) storing the rotation rate sensed by the rotation sensing part (40) while the one of the kneading drums (11, 13) rotates during a first predetermined period of time, comparing the stored rotation rate with a rotation rate sensed by the rotation sensing part while the one of the kneading drums (11, 13) rotates during a next predetermined period of time, and stopping the drum driving part (25) when a difference between the stored rotation rate and the sensed rotation rate for the next period of time exceeds an allowable limit.

FIG. 7



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Description

[0001] The present invention relates to bread makers and to methods of controlling bread makers.

[0002] Generally, making bread is so complicated that it is difficult for an average person to manually make satisfactory bread at home. That is, making the bread includes multiple steps of mixing ingredients such as flour, sugar, yeast, etc., to form a dough; kneading the dough, leavening the dough; baking the dough; and so on.

[0003] Therefore, various bread makers have been developed to allow a user to easily make bread. The bread maker automatically performs the foregoing multiple steps and provides finished bread to the user.

[0004] For example, a bread maker disclosed in Korean Patent Publication No. KR-A-1991-10203 includes a pair of parallel kneading drums at upper and lower parts of an oven compartment that reverse rotary direction periodically, a baking tray between the pair of kneading drums, a heater heating the inside of the oven compartment, a bar code scanner, etc.

[0005] In the bread maker, disclosed in Korean Patent Publication No. KR-A-1991-10203, upper and lower ends of a mixing bag filled with flour, water, etc., are attached to the upper and lower kneading drums, and then the mixing bag is reciprocated up and down for a predetermined period of time, thereby kneading the dough in the mixing bag.

[0006] After completing the kneading of the dough, the mixing bag is automatically separated from the upper kneading drum, and wound on the lower kneading drum, with the dough being squeezed out of the mixing bag and into the baking tray. Thereafter, a heater heats the inside of the oven compartment, thereby leavening and baking the dough for a predetermined period of time.

[0007] The bread is made according to a bar code that is printed on the mixing bag that includes information on kneading time, leavening time, baking time, etc., for a particular recipe. That is, the bar code is read by the bar code scanner and the read data is transmitted to a controller, so that the controller controls the kneading drums, the heater, etc., on the basis of the read data.

[0008] However, in the conventional bread maker, while the mixing bag is reciprocated up and down to knead the dough, if the upper and lower kneading drums do not rotate synchronously, or if the mixing bag separates from the upper or lower kneading drum because, for example, the mixing bag tears, the mixing bag is incorrectly attached to the upper and lower kneading drums, etc., internal components of the bread maker may be damaged.

[0009] It is an aim of preferred embodiments of the present invention to provide a bread maker and a control method thereof, that can prevent internal components of the bread maker from being damaged due to non-synchronous rotation between the upper and lower kneading drums, an incorrect installation of a mixing

bag, etc.

[0010] According to the present invention in a first aspect, there is provided a bread maker including a main body divided into an oven compartment and an electric component compartment; a pair of parallel kneading drums spaced apart from each other inside the oven compartment, to which are attachable opposite ends of a mixing bag containing ingredients for bread, the kneading drums reversing rotary direction periodically; a drum driving part in the electric component compartment rotating the kneading drums in clockwise and counterclockwise directions; a rotation sensing part sensing a rotation rate of one of the kneading drums; and a controller storing the rotation rate sensed by the rotation sensing part while the one of the kneading drums rotates during a first predetermined period of time, comparing the stored rotation rate with a rotation rate sensed by the rotation sensing part while the one of the kneading drums rotates during a next predetermined period of time, and stopping the drum driving part when a difference between the stored rotation rate and the sensed rotation rate for the next period of time exceeds an allowable limit.

[0011] Suitably, the rotation sensing part includes a disk part rotating with the one of the kneading drums, and having at least one projection radially extending from a circumference thereof; and a disk sensor emitting a light toward the disk part and outputting a pulse signal according to interruption of the light by rotation of the at least one projection of the disk part.

[0012] Suitably, the disk part includes a first disk having a single projection; and a second disk having a plurality of projections along a circumference thereof at regular intervals.

[0013] Suitably, the disk sensor comprises a light emitting part and a light receiving part facing each other with the disk part therebetween, the disk sensor outputting a pulse signal when the at least one projection of the disk part interrupts light emitted from the light emitting part to the light receiving part.

[0014] Suitably, the controller includes a memory storing the pulse signal output during the first period of time, and the controller compares a difference in pulse widths between the pulse signal stored in the memory and the pulse signal output from the pulse generator during the next period of time.

[0015] According to the present invention in a second aspect, there is provided a method of controlling a bread maker having an oven compartment and an electric component compartment, a pair of parallel kneading drums inside the oven compartment to which are attachable opposite ends of a mixing bag containing bread ingredients, the kneading drums reversing rotary direction periodically, and a drum driving part in the electric component compartment rotating the kneading drums clockwise and counterclockwise, the method including sensing a rotation rate of one of the kneading drums for a first predetermined period of time; storing the sensed

rotation rate; comparing the stored rotation rate with the rotation rate sensed while the one of the kneading drums rotates during a next period of time; and stopping the drum driving part when a difference between the stored rotation rate and the rotation rate sensed during the next period of time exceeds an allowable limit.

[0016] Suitably, the bread maker further includes a rotation sensing part including a disk part rotating with the one of the kneading drums and having a plurality of projections around a circumference thereof at regular intervals; and a disk sensor outputting a pulse signal according to interruption, by the projections of the disk part, of light emitted toward the disk part, wherein the sensed rotation rate that is stored is based upon the pulse width of the pulse signal output from the disk sensor while the one of the kneading drums rotates for the predetermined period of time.

[0017] Suitably, comparing the stored rotation rate and the sensed rotation rate of the next period of time includes comparing pulse widths of the pulse signals output during the first period of time and the next period of time, respectively.

[0018] Suitably, the method further includes providing a warning when a difference between the stored rotation rate and the sensed rotation rate of the next period of time exceeds an allowable limit.

[0019] These together with other aspects and advantages which will be subsequently apparent, reside in the details of construction and operation as more fully hereinafter described and claimed, reference being had to the accompanying drawings forming a part thereof, wherein like numerals refer to like parts throughout.

[0020] Further features of the present invention are set out in the appended claims.

[0021] The present invention will become apparent and more readily appreciated from the following description of the embodiments, by way of example only, taken in conjunction with the accompanying drawings, of which:

Figure 1 is a perspective view of a bread maker according to an embodiment of the present invention; Figure 2 is a perspective view of an electric component compartment of the bread maker shown in FIG. 1;

Figure 3 is an exploded perspective view of a portion of the electric component compartment of FIG. 2;

Figure 4 is a front view of a mixing bag used in the bread maker according to the embodiment of the present invention;

Figure 5 is a control block diagram of the bread maker according to the embodiment of the present invention;

Figures 6A and 6B illustrate pulse signals output from a rotation sensor according to the embodiment of the present invention; and

Figure 7 is a flowchart illustrating control of the bread maker according to the embodiment of the

present invention.

[0022] Hereinafter, an embodiment of the present invention will be described in detail with reference to the attached drawings, wherein the like reference numerals refer to the like elements throughout. The present invention may, however, be embodied in many different forms and should not be construed as being limited to the embodiment set forth herein; rather, this embodiment is provided so that the present disclosure will be thorough and complete, and will fully convey the concept of the invention to those skilled in the art.

[0023] As shown in Figures 1 through 3, a bread maker according to an embodiment of the present invention includes a main body 1 divided into an oven compartment 10 and an electric component compartment 20, a door 3 in the front of the main body 1 to open and close the front opening of the oven compartment 10, and a control panel 5 in the front of the main body 1 to allow a user to control the bread maker and know the state of the bread maker. Inside the oven compartment 10, upper and lower kneading drums 11 and 13 are provided in parallel and reversibly rotate. Opposite ends 8 of a mixing bag 7 (refer to Figure 4) filled with raw materials (ingredients) for bread are attached to projections 12 on the upper and lower kneading drums 11 and 13, and the mixing bag 7 is wound.

[0024] In a lower part of the oven compartment 10, there is a baking tray 15 in which the dough is baked between the upper and lower kneading drums 11 and 13. In a lower part of the oven compartment 10, there is a baking tray 15 in which the dough is baked between the upper and lower kneading drums 11 and 13. The baking tray 15 includes first and second trays 15a and 15b, each having an "L"-shaped section symmetrical to one another that combine into a box shape having an open top. In an upper part of the oven compartment 10, a pair of squeezing members 17 is between the upper kneading drum 11 and the baking tray 15 that kneads the dough contained in the mixing bag 7 within the baking tray 15, preventing the dough from moving outside the baking tray 15.

[0025] At upper and lower parts of the inside walls of the oven compartment 10 and the door 3 are heaters 19 for heating the inside of the oven compartment 10.

[0026] The electric component compartment 20 includes a first component compartment 21 placed beside the oven compartment 10 and a second component compartment 23 placed behind the oven compartment 10. Inside the first component compartment 21 is a drum driving part 25 that rotates the upper and lower kneading drums 11 and 13 in clockwise and counterclockwise directions. Inside the second component compartment 23 is a bar code scanner 29 that reads a bar code 9 printed on or applied to the mixing bag 7 that is wound on the upper and lower kneading drums 11 and 13. The bar code scanner 29 may move close to, and distantly from, an outer circumference of the upper kneading drum 11.

[0027] The drum driving part 25 includes a motor 26 that rotates the lower kneading drum 13, and a belt 27 that transmits a rotary movement of the lower kneading drum 13 to a rotation shaft 28 of the upper kneading drum 11.

[0028] A rotation sensing part 40 senses rotation of at least one of the upper and lower kneading drums 11 and 13, and a controller 70 (described below) stops the drum driving part 25 when a pulse signal output by the rotation sensing part 40 is greater than a predetermined allowable pulse width.

[0029] The rotation sensing part 40 includes a disk part 41 attached to the rotation shaft 28 of the upper kneading drum 11, and a rotation sensor 61 placed near the disk part 41 that outputs a pulse signal by sensing the rotation of the disk part 41.

[0030] The disk part 41 includes a first disk 36 that allows the rotation sensor 61 to sense one turn of the upper kneading drum 11, and a second disk 37 that allows the rotation sensor 61 to sense a rotation of the upper kneading drum 11 that is less than one revolution.

[0031] The first disk 36 is a circular plate 43, which is separated from the second disk 37 by a cylindrical part 52 and connected to the rotation shaft 28 of the upper kneading drum 11 using a washer 54 and a bolt 56. The circular plate 43 is formed with a single projection 44 radially extended therefrom. Hence, the first disk 36 rotates with the upper kneading drum 11 and allows the rotation sensor 61 to sense one revolution of the upper kneading drum 11.

[0032] The second disk 37 is a circular plate 47 with a shaft combining hole 46 used to attach the circular plate 47 to the rotation shaft 28 of the upper kneading drum 11. The circular plate 47 has a plurality of slots 49 along the circumference thereof at regular intervals, forming a plurality of projections 48. For example, in the embodiment shown in FIG. 3, the second disk 37 has twenty-four slots 49, forming twenty-four projections 48. Hence, the second disk 37 rotates with the upper kneading drum 11 and allows the rotation sensor 61 to sense a rotation of the upper kneading drum 11 that is less than one complete turn.

[0033] The rotation sensor 61 includes a first disk sensor 63 sensing the single projection 44 of the first disk 36 and outputting one pulse signal per one revolution of the upper kneading drum 11, and a second disk sensor 65 sensing the twenty-four projections 48 of the second disk 37 and outputting twenty-four pulse signals per revolution of the upper kneading drum 11. That is, while the upper kneading drum 11 makes one revolution, the first and second disk sensors 63 and 65 output one and twenty-four pulse signals, respectively.

[0034] The first and second disk sensors 63 and 65 include light emitting parts 63a and 65a that emit a sensing signal such as infrared rays toward the first and second disks 36 and 37, and light receiving parts 63b and 65b that face the light emitting parts 63a and 65a, respectively, across the first and second disks 36 and 37

and receive the light emitted from the light emitting parts 63a and 65a, respectively.

[0035] The first disk sensor 63 senses when the single projection 44 of the first disk 36 interrupts the light emitted from the light emitting part 63a to the light receiving part 63b, thereby outputting one pulse signal per revolution of the upper kneading drum 11.

[0036] The second disk sensor 65 senses when the twenty-four projections 48 of the second disk 37 interrupt the light emitted from the light emitting part 65a to the light receiving part 65b, thereby outputting twenty-four pulse signals per one complete turn of the upper kneading drum 11.

[0037] The rotation sensor 61 transmits the pulse signals output from the first and second disk sensors 63 and 65 to the controller 70, and the controller 70 determines a rotation rate of the upper kneading drum 11 on the basis of the output pulse signals. Thus, the controller 70 controls the motor 26 of the drum driving part 25 to rotate the upper and lower kneading drums 11 and 13 according to the determined rotation rate thereof, thereby causing the mixing bag 7 to be properly reciprocated up and down.

[0038] Thus, as shown in Figure 5, the bread maker according to this embodiment of the present invention includes the first and second disk sensors 63 and 65 sensing the rotation of the first and second disks 36 and 37, and the controller 70 determining whether the upper and lower kneading drums 11 and 13 are operating in a normal or abnormal state based upon the pulse signals output from the first and second disk sensors 63 and 65.

[0039] The controller 70 stores in a memory 71 the pulse widths of the pulse signals output from the first and second disk sensors 63 and 65 as the first and second disks 36 and 37 make one revolution. The controller 70 compares the pulse widths stored in the memory 71 with the pulse widths of the pulse signals output from the first and second disk sensors 63 and 65 as the first and second disks 36 and 37 make the next revolution. When there is a difference between the pulse widths stored in the memory 71 as the first and second disks 36 and 37 make one revolution and the pulse widths of the pulse signals output from the first and second disk sensors 63 and 65 as the first and second disks 36 and 37 make the next revolution, and the difference exceeds an allowable limit, the controller 70 determines that the upper and lower kneading drums 11 and 13 are operating in an abnormal state and stop the motor 26. Also, the control panel 5 in the front of the electric component compartment 20 warns a user of the abnormal state.

[0040] Figures 6A and 6B illustrate the pulse signals output from the first and second disk sensors 63 and 65. As shown therein, while the upper kneading drum 11 makes one complete turn, the first and second disk sensors 63 and 65 output one and twenty-four pulse signals, respectively.

[0041] In a normal state, the light receiving part 65b of the second disk sensor 65 outputs one pulse signal

per 1 msec (millisecond). However, in an abnormal state, for example, where the mixing bag 7 separates from the lower kneading drum 13, the upper kneading drum 11 becomes overloaded and the motor 26 cannot rotate the upper kneading drum 11 as fast as the motor 26 rotates the upper kneading drum 11 in the normal state, so that the light receiving parts 63b and 65b output pulse signals per unit of time that are greater than 1 msec. In other words, in the abnormal state, the first and second disks 36 and 37 rotate slower than in the normal state, so that in the abnormal state a pulse width is larger than in the normal state. The pulse width indicates a load applied to the motor 26, so that the larger the pulse width, the higher the current that flows in the motor 26, which may damage the motor 26.

[0042] The bread maker according to this embodiment of the present invention is controlled as follows. Referring to FIG. 7, first, the pulse signal due to the second disk 37 is sensed while the upper kneading drum 11 makes one revolution (S1), and the memory 71 stores the rotation rate (pulse width) based upon the sensed pulse signal (S3). Thereafter, the pulse signal due to the second disk 37 is sensed while the upper kneading drum 11 makes the next revolution (S5). Then, the rotation rate sensed while the upper kneading drum 11 makes the next revolution is compared with the rotation rate stored in the memory 71 to determine whether a difference between the two rotation rates exceeds the allowable limit (S7). When the difference exceeds the allowable limit, it is determined that the upper kneading drum 11 is operating in an abnormal state in which, for example, the mixing bag is incorrectly attached to the upper and lower kneading drums 11 and 13, and the motor 26 is stopped (S9). Finally, the control panel 5 warns a user of the abnormal state (S11).

[0043] In the foregoing embodiment, the first and second disks 36 and 37 are formed with the projections 44 and 48, respectively, to sense the rotations of the upper and lower kneading drums 11 and 13. However, the first and second disks 36 and 37 may be formed with a plurality of holes at regular intervals to sense the rotation of the upper and lower kneading drums 11 and 13.

[0044] According to this embodiment of the present invention, while the mixing bag 7 is reciprocated up and down to knead the dough, the internal components of the bread maker are prevented from damage caused by, for example, the upper and lower kneading drums rotating asynchronously, or the mixing bag separating from the upper or lower kneading drum because the mixing bag 7 tears, is incorrectly attached to the upper and lower kneading drums, etc.

[0045] As described above, this embodiment of the present invention provides a bread maker and a control method thereof capable of preventing internal components of the bread maker from becoming damaged due to, for example, asynchronous rotation of the upper and lower kneading drums, an incorrect installation of a mixing bag, etc.

[0046] Although an embodiment of the present invention has been shown and described, it will be appreciated by those skilled in the art that changes may be made in these embodiments without departing from the principles and spirit of the invention, the scope of which is defined in the appended claims and their equivalents.

[0047] Attention is directed to all papers and documents which are filed concurrently with or previous to this specification in connection with this application and which are open to public inspection with this specification, and the contents of all such papers and documents are incorporated herein by reference.

[0048] All of the features disclosed in this specification (including any accompanying claims, abstract and drawings), and/or all of the steps of any method or process so disclosed, may be combined in any combination, except combinations where at least some of such features and/or steps are mutually exclusive.

[0049] Each feature disclosed in this specification (including any accompanying claims, abstract and drawings) may be replaced by alternative features serving the same, equivalent or similar purpose, unless expressly stated otherwise. Thus, unless expressly stated otherwise, each feature disclosed is one example only of a generic series of equivalent or similar features.

[0050] The invention is not restricted to the details of the foregoing embodiment(s). The invention extends to any novel one, or any novel combination, of the features disclosed in this specification (including any accompanying claims, abstract and drawings), or to any novel one, or any novel combination, of the steps of any method or process so disclosed.

35 Claims

1. A bread maker, comprising:

a main body (1) divided into an oven compartment (10) and an electric component compartment (20);

a pair of parallel kneading drums (11, 13) spaced apart from each other inside the oven compartment (10), to which are attachable opposite ends of a mixing bag (7) containing ingredients, the kneading drums (11, 13) reversing rotary direction periodically;

a drum driving part (25) in the electric component compartment (20) rotating the kneading drums (11, 13) in clockwise and counterclockwise directions;

a rotation sensing part (40) sensing a rotation rate of one of the kneading drums (11, 13); and a controller (70) storing the rotation rate sensed by the rotation sensing part (40) while the one of the kneading drums (11, 13) rotates during a first predetermined period of time, comparing the stored rotation rate with a rotation rate

- sensed by the rotation sensing part (40) while the one of the kneading drums (11, 13) rotates during a next predetermined period of time, and stopping the drum driving part (25) when a difference between the stored rotation rate and the sensed rotation rate for the next period of time exceeds an allowable limit.
2. The bread maker according to claim 1, wherein the rotation sensing part (40) comprises:
 - a disk part (41) rotating with the one of the kneading drums (11, 13), and having at least one projection (44, 48) radially extending from a circumference thereof; and
 - a disk sensor (61) emitting a light toward the disk part (41) and outputting a pulse signal according to interruption of the light by rotation of the at least one projection (44, 48) of the disk part (41).
 3. The bread maker according to claim 2, wherein the disk part (41) comprises:
 - a first disk (36) having a single projection (44); and
 - a second disk (37) having a plurality of projections (40) along a circumference thereof at regular intervals.
 4. The bread maker according to claim 2 or claim 3, wherein the disk sensor (61) comprises a light emitting part (63a, 65a) and a light receiving part (63b, 65b) facing each other with the disk part (41) therebetween, the disk sensor (61) outputting a pulse signal when the at least one projection (44, 48) of the disk part (41) interrupts light emitted from the light emitting part (63a, 65a) to the light receiving part (63b, 65b).
 5. The bread maker according to claim 4, wherein the controller (70) includes a memory (71) storing the pulse signal output during the first period of time, and the controller (70) compares a difference in pulse widths between the pulse signal stored in the memory (71) and the pulse signal output from the pulse generator during the next period of time.
 6. The bread maker according to any one of claims 2-5, wherein the disk part (41) is attached to a rotation shaft (28) of the one of the kneading drums (11, 13).
 7. The bread maker according to any one of claims 3-6, wherein the disk sensor (61) senses one revolution of the one of the kneading drums (11, 13) using the first disk (36), and the disk sensor (61) senses rotation of the one of the kneading drums (11, 13) that is less than one revolution using the second disk (37).
 8. The bread maker according to any one of claims 3-7, wherein the disk sensor (61) outputs one pulse signal per revolution of the one of the kneading drums (11, 13), and outputs a number of pulse signals per revolution of the one of the kneading drums (11, 13) equal to the number of projections on the second disk (37).
 9. The bread maker according to any one of claims 3-8, wherein the kneading drums (11, 13) comprise an upper kneading drum (11) and a lower kneading drum (13).
 10. The bread maker according to claim 9, wherein the drum driving part (25) comprises a motor (26) to rotate the lower kneading drum (13) and a belt (27) connecting the lower kneading drum (13) to the upper kneading drum (11), the belt (27) transmitting a rotary movement of the lower kneading drum (13) to the upper kneading drum (11).
 11. The bread maker according to claim 10, wherein the controller (70) determines a rotation rate of the upper kneading drum (11) using the output pulse signals and controls the motor (26) to rotate the upper kneading drum (11) and the lower kneading drum (13) according to the determined rotation rate.
 12. The bread maker according to claim 10, wherein when the pulse width of the pulse signals is greater than the predetermined pulse width, the controller (70) determines a state of the bread maker to be abnormal and that the motor (26) is overloaded, with the first disk (36) and the second disk (37) rotating slower than rotation thereof in a normal state.
 13. A method of controlling a bread maker having an oven compartment (10) and an electric component (20) compartment, a pair of parallel kneading drums (11, 13) inside the oven compartment (10) to which are attachable opposite ends of a mixing bag (7) containing ingredients, the kneading drums (11, 13) reversing rotary direction periodically, and a drum driving part (25) in the electric component compartment (20) rotating the kneading drums (11, 13) clockwise and counterclockwise, the method comprising:
 - sensing a rotation rate of one of the kneading drums (11, 13) for a first predetermined period of time;
 - storing the sensed rotation rate;
 - comparing the stored rotation rate with the rotation rate sensed while the one of the kneading drums (11, 13) rotates during a next period of

time; and
stopping the drum driving part (25) when a difference between the stored rotation rate and the rotation rate sensed during the next period of time exceeds an allowable limit.

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14. The method according to claim 13, wherein the bread maker includes a rotation sensing part (40) having a disk part (41, 37) rotating with the one of the kneading drums (11, 13), the disk part (41, 37) having a plurality of projections (48) around a circumference thereof at regular intervals, and a disk sensor (61) outputting a pulse signal as the projections of the disk part (41, 37) interrupt light emitted toward the disk part (41, 37), wherein
- storing of the sensed rotation rate is based upon the pulse width of the pulse signal output from the disk sensor (61) while the one of the kneading drums (11, 13) rotates for the first predetermined period of time.
15. The method according to claim 14, wherein the comparing of the stored rotation rate and the sensed rotation rate of the next period of time includes comparing pulse widths of the pulse signals output during the first period of time and the next period of time, respectively.
16. The method according to any one of claims 13-15, further comprising providing a warning when a difference between the stored rotation rate and the sensed rotation rate of the next period of time exceeds an allowable limit.

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FIG. 1

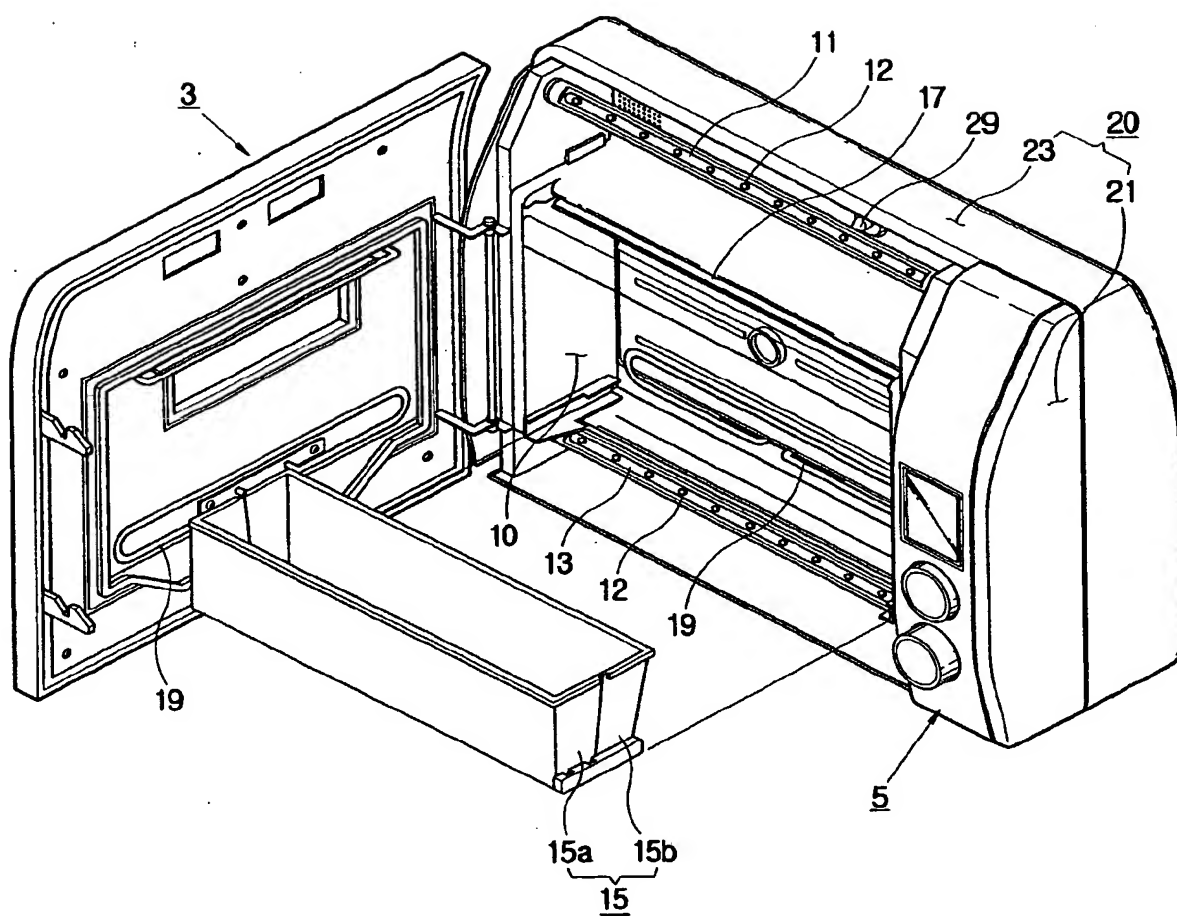


FIG. 2

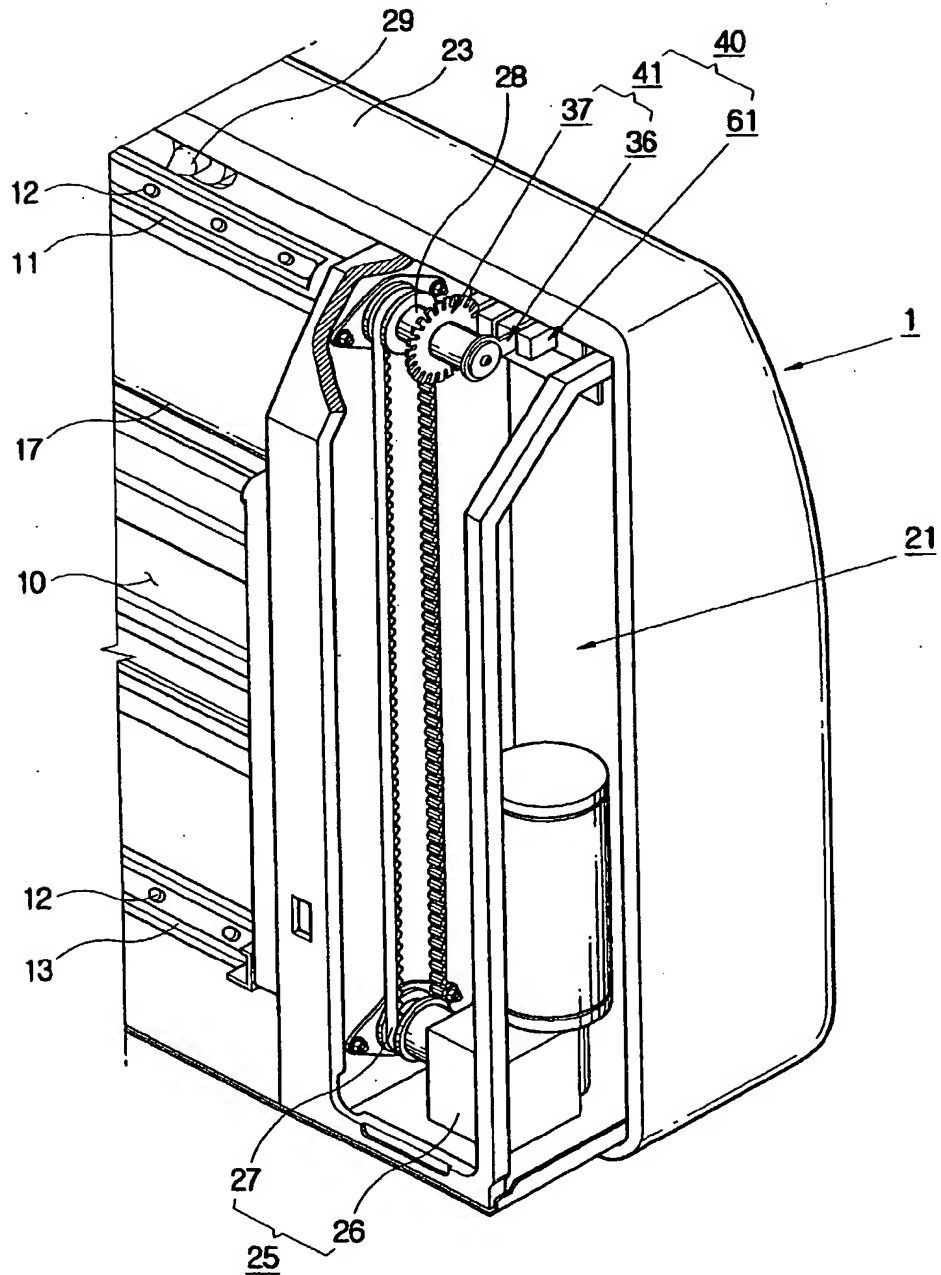


FIG. 3

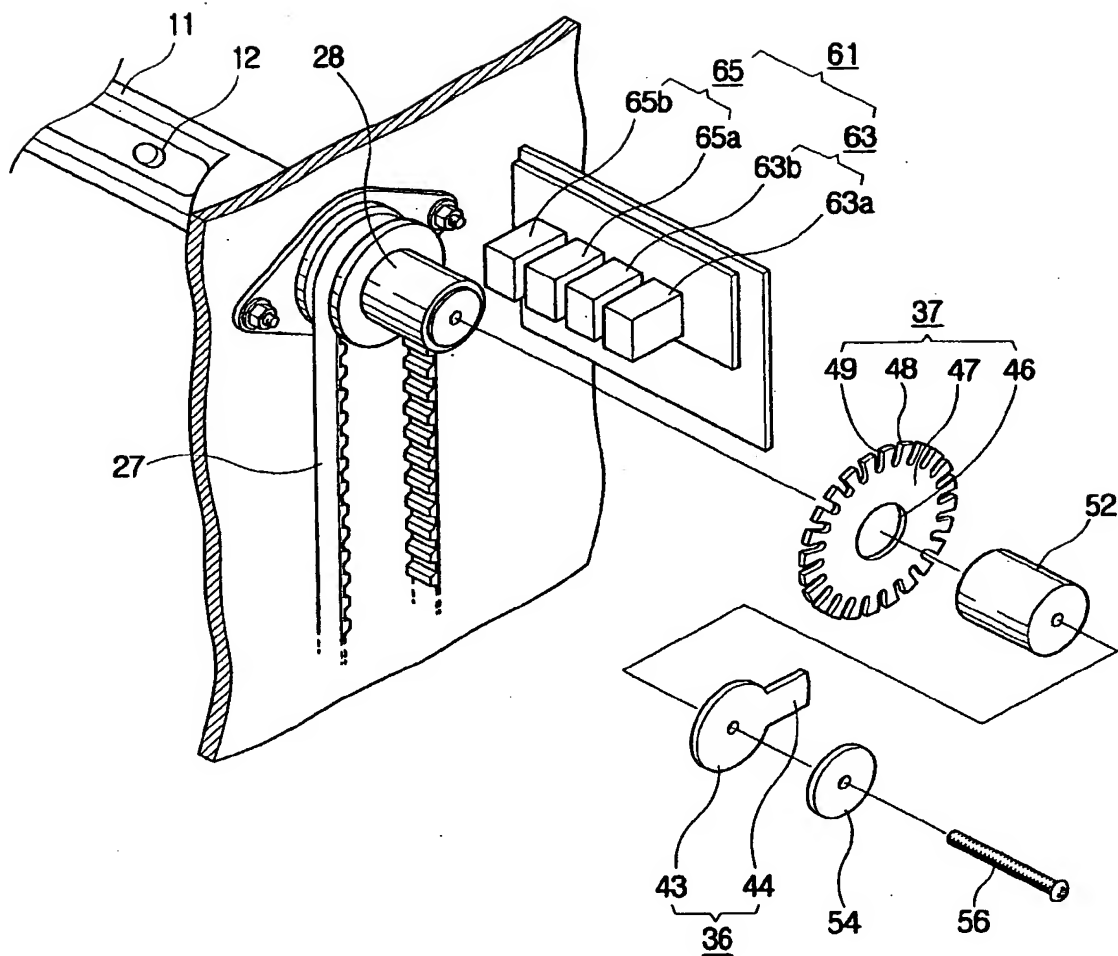


FIG. 4

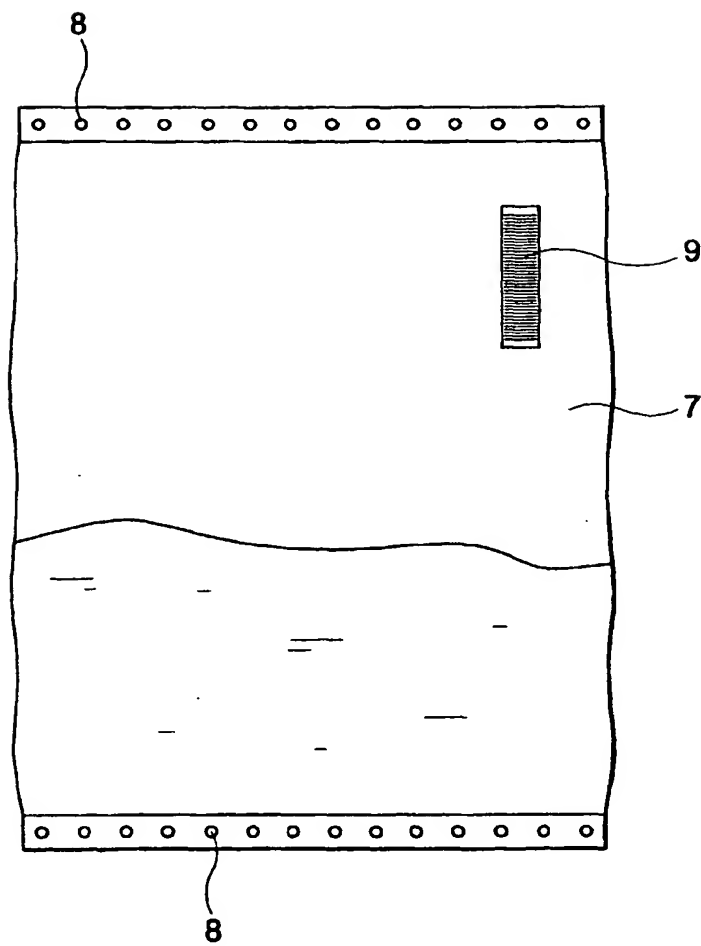


FIG. 5

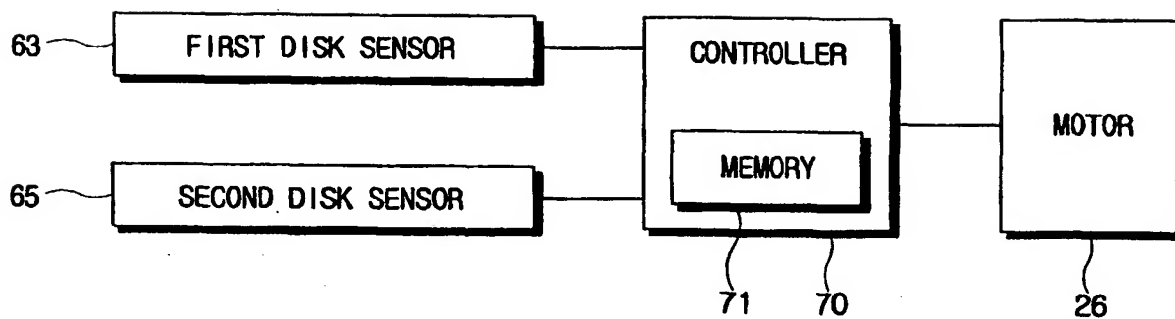
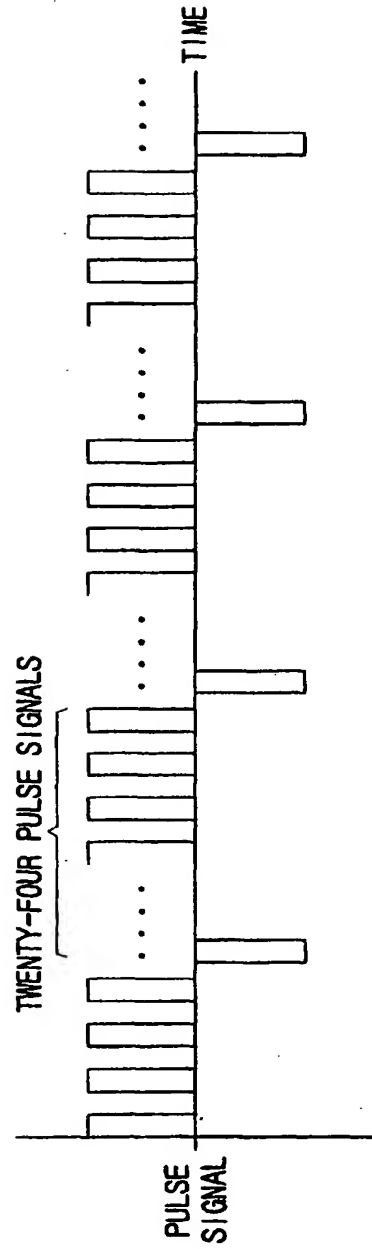
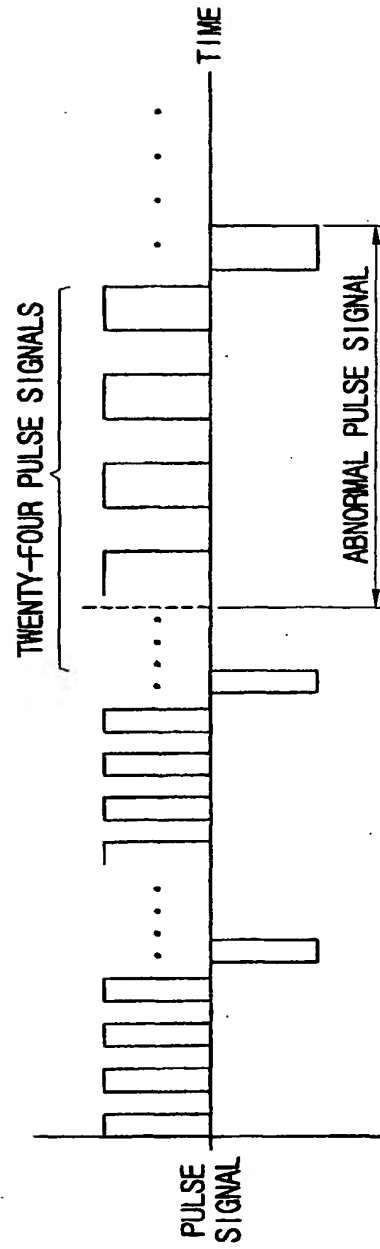


FIG. 6

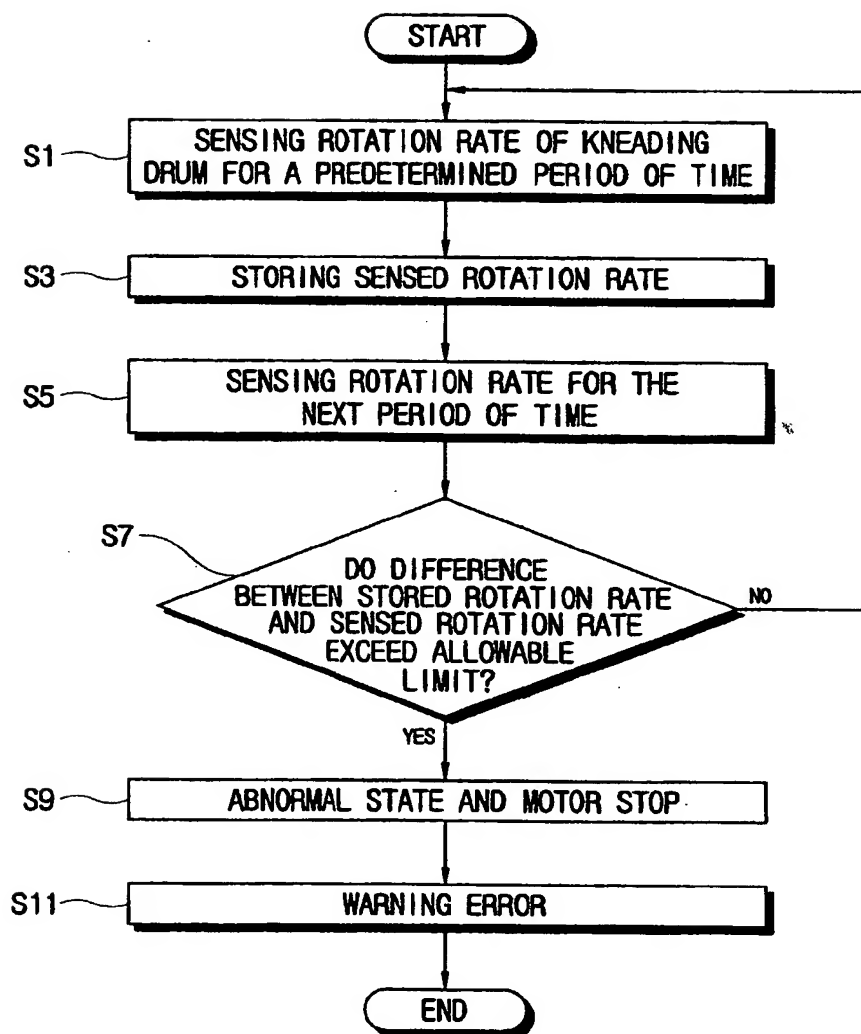


a) NORMAL STATE



b) ABNORMAL STATE

FIG. 7





European Patent
Office

EUROPEAN SEARCH REPORT

Application Number
EP 03 25 2439

DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.7)
A	US 5 947 009 A (HEDENBERG ROLF P) 7 September 1999 (1999-09-07) * the whole document *	1,13	A21B7/00
A	US 5 146 840 A (HEDENBERG ROLF P) 15 September 1992 (1992-09-15) * the whole document *	1,13	
A	US 4 803 086 A (HEDENBERG GUNNAR) 7 February 1989 (1989-02-07) * the whole document *	1,13	
			TECHNICAL FIELDS SEARCHED (Int.Cl.7)
			A21B
The present search report has been drawn up for all claims			
Place of search THE HAGUE		Date of completion of the search 28 October 2003	Examiner Silvis, H
CATEGORY OF CITED DOCUMENTS X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document			

EPO FORM 1503 03.82 (P04C01)

**ANNEX TO THE EUROPEAN SEARCH REPORT
ON EUROPEAN PATENT APPLICATION NO.**

EP 03 25 2439

This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report. The members are as contained in the European Patent Office EDP file on
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28-10-2003

Patent document cited in search report		Publication date		Patent family member(s)	Publication date
US 5947009	A	07-09-1999	AT	235312 T	15-04-2003
			AU	737768 B2	30-08-2001
			AU	1414599 A	07-06-1999
			BR	9814876 A	03-10-2000
			CA	2310844 A1	27-05-1999
			DE	69812691 D1	30-04-2003
			EA	1996 B1	22-10-2001
			EP	1032468 A1	06-09-2000
			HU	0100951 A2	28-12-2001
			JP	2001523444 T	27-11-2001
			NO	20002561 A	18-05-2000
			NZ	504301 A	30-11-2001
			PL	340637 A1	12-02-2001
			TW	391867 B	01-06-2000
			WO	9925467 A1	27-05-1999
			ZA	9810497 A	14-07-1999
US 5146840	A	15-09-1992	WO	9210100 A1	25-06-1992
US 4803086	A	07-02-1989	WO	8603931 A1	17-07-1986
			AT	393771 B	10-12-1991
			AT	903086 A	15-06-1991
			AT	47002 T	15-10-1989
			BE	906013 A1	16-04-1987
			BR	8507305 A	03-11-1987
			BR	8607054 A	23-02-1988
			CA	1268665 A1	08-05-1990
			CH	671321 A5	31-08-1989
			DE	3573512 D1	16-11-1989
			DE	3690660 C2	27-05-1993
			DE	3690660 T	10-03-1988
			DK	393186 A	19-08-1986
			DK	409587 A	06-08-1987
			WO	8703784 A1	02-07-1987
			ES	2003997 A6	01-12-1988
			FI	872791 A ,B,	23-06-1987
			FI	873605 A ,B,	20-08-1987
			FR	2591865 A1	26-06-1987
			GB	2191928 A ,B	31-12-1987
			JP	6055102 B	27-07-1994
			JP	1500320 T	09-02-1989
			KR	9110203 B1	21-12-1991
			NL	8620514 T	23-12-1985
			NO	863316 A ,B,	18-08-1986
			NO	873503 A ,B,	19-08-1987
			SE	465994 B	02-12-1991

EPO FORM P0459

For more details about this annex : see Official Journal of the European Patent Office, No. 12/82

ANNEX TO THE EUROPEAN SEARCH REPORT
ON EUROPEAN PATENT APPLICATION NO.

EP 03 25 2439

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The members are as contained in the European Patent Office EDP file on
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28-10-2003

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 4803086 A	SE	8703161 A	14-08-1987

EPO FORM P0459

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